MPA3 V5.4 MOTOR PROTECTION RELAY (Suitable for General Industrial Applications) USER MANUAL

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Designed and Manufactured in Australia by Ampcontrol CSM Pty Limited.

AMPCONTROL®

Safety and other Warnings

WARNING! 	**This safety alert symbol identifies important safety messages in this manual and indicates a potential risk of injury or even death to the personnel. When you see this symbol, be alert, your safety is involved, carefully read the message that follows, and inform other operators.**

CAUTION! 	**This safety alert symbol identifies important information to be read in order to ensure the correct sequence of work and to avoid damage or even destruction of the equipment, and reduce any potential risk of injury or death to the personnel.**

	Supplementary information not directly affecting safety or damage to equipment. Carefully read the message that follows, and inform other relevant personnel.

	**Information concerning possible impact on the environment and actions required for prevention and proper response.**

If this document is being read via a computer the hyper links may be used (Press control and click on the blue highlighted text to go to that topic).

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Ampcontrol further reserves the right to alter the specification of the system and/or manual without obligation to notify any person or organisation of these changes.

Before You Begin

We would like to take a moment to thank you for purchasing the MPA3 V5 Motor Protection Relay.

WARNING! 	**To ensure the correct and safe operation of this equipment the user is to become completely familiar with the safety requirements and correct operating procedures detailed in this user manual.**

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1 Receiving and Storage

1.1 Receiving

All possible precautions are taken to protect the equipment against damage or losses during shipment, however before accepting delivery, check all items against the packing list or Bill of Lading. If there are shortages or evidence of physical damage, notify Ampcontrol immediately.

Notify Ampcontrol within 7 days (maximum) in case of shortages or discrepancies, according to the packing list. This action will help ensure a speedy resolution to any perceived problems. Keep a record of all claims and correspondence. Photographs are recommended.

Where practicable do not remove protective covers prior to installation unless there are indications of damage. Boxes opened for inspection and inventory should be carefully repacked to ensure protection of the contents or else the parts should be packaged and stored in a safe place. Examine all packing boxes, wrappings and covers for items attached to them, especially if the wrappings are to be discarded.

1.2 Storage after Delivery

When the equipment is not to be installed immediately, proper storage is important to ensure protection of equipment and validity of warranty.

All equipment should be stored indoors protected from the elements in a cool dry area. If storing on the ground, ensure that the storage area is not an area where water will collect.

1.3 Unpacking of Equipment

The method of packing used will depend on the size and quantity of the equipment. The following cautions should be interpreted as appropriate.

CAUTION! 	**Take care when unpacking crates as the contents may have shifted during transport.** **Make sure that cable drums are securely attached to their shipping pallets before attempting to move them (if applicable).**

 *ENVIRONMENTAL ALERT*	The disposal of packaging materials, replaced parts, or components must comply with environmental restrictions without polluting the soil, air or water. Ensure that any timber and cardboard used as packaging is disposed of in a safe and environmentally responsible manner. Where possible, dispose of all waste products i.e. oils, metals, plastic and rubber products by using an approved recycling service centre.

2 General safety

2.1 Personnel Safety Warnings

2.1.1 Relevant Personnel

Ensure all personnel directly responsible or involved with the installation, operation and maintenance of the equipment reference this manual in conjunction with any relevant risk assessments to identify all foreseeable hazards.

2.1.2 Safety Communication

All safety instructions and design requirements within this manual must be communicated to all users. These requirements are necessary to identify and control any foreseeable risk associated with this piece of equipment. In the event of any damage or malfunction that results in the potential to harm the health or safety of any person; the owner/operator should notify the manufacturer immediately.

2.2 Safe Use of Equipment

Equipment supplied has been manufactured within the guide lines of the relevant Australian Standards and state legislative requirements. Equipment identified within this manual has been designed for a specific intended purpose; therefore any modification or damage must be reported to the manufacturer for repair.

The instructions within this manual must be observed as an aid towards achieving maximum safety during operation.

2.2.1 Changes to Equipment

Changes in the design and modifications to the equipment are not permitted

2.2.2 Equipment Knowledge

Experience with, or understanding of, this equipment is essential for the safe installation and removal of the equipment. If in doubt, contact Ampcontrol immediately.

Mechanical and or Electrical installation, and maintenance of plant and equipment, must only be carried out by appropriately trained, qualified and competent personnel.

3 Overview of MPA3 V5 Relay

3.1 General Description

The Ampcontrol MPA Motor Protection Relay has been designed to provide optimum overload protection of small to medium sized 415 V motors used on conveyors, pumps, fans and compressors. It can also be used with higher voltage motors. In addition to motor protection the relay has features to monitor temperature, provide alarms before a trip condition and through a 50 record event log allows diagnosis of a problem after a fault has occurred. The standard current transformers supplied with the MPA Protection Relay enable protection of motors with full load currents ranging from 5.125 A to 640 A. The selected full load current can be set to one of 224 values across the range.

The MPA Motor Protection Relay has 5 digital inputs, which feed into a microprocessor unit. The microprocessor has been programmed to control three output relays: MTR (Main Trip Relay), ALM (Alarm Relay) and AUX (Auxiliary Relay).

Inputs are also provided for PTC Thermistors and current transformers.

A two-line backlit LCD display used in conjunction with a keypad provides an easy to use operator interface. The display provides easy access to all available information. A simple procedure allows adjustment of the relay's settings.

The Energy Storage Module allows the MPA Relay to function normally for a period of two seconds during an extreme power dip or power loss.

The MPA's event log and adjustable settings are backed up with a battery. The battery is not user replaceable (return the MPA Relay to Ampcontrol for replacement of the battery).

The MPA is housed in an enclosure suitable for flush mounting in a 135 mm square cut out and has robust plug in connectors on the rear.

3.2 Protection Functions

The Ampcontrol MPA motor Protection Relay provides protection functions for:

- Overload
- Short Circuit
- Earth Leakage
- Motor Contactor Fail
- Phase Current Unbalance
- Undercurrent/Over-current Alarms
- Over Temperature - PTC Thermistor
- Optional Under-voltage
- Optional Insulation Test
- Optional PT-100 RTD Temperature Protection

3.3 Optional Monitoring Modules

3.3.1 MPA-M

This optional monitoring module (MPA-M) can be utilised to provide the following features:

- Five PT-100 RTD inputs, which are arranged in two groups; three for the stator and two for the bearings.
- RS485 Modbus RTU communication port that can be connected to Motor Starter PLC's, or a central monitoring system, for continuous monitoring and fault-finding.
- A 0-20 mA/4-20 mA Analogue Output.

3.3.2 MPA-I

This is an optional insulation test module which allows frequent testing of motor insulation.

3.3.3 MPA-M (e)

This optional monitoring module has the same features as the MPA-M module except the RS485 Modbus communication port is replaced by an EtherNet/IP communications port.

4 Basic Display Operation

The facia of the MPA Motor Protection Relay has a two line 16-character backlit LCD display, Status LED and a tactile keypad.

The layout of the display structure is shown on the '**MPA Display Map**'. The display level is changed with the Up/Down arrow keys and the Left/Right arrow keys control the display Position. See drawing '**MPA Display Map' MPA-B-003**, in Appendix A – Drawings.

The ENT and ESC keys are used to modify settings and provide hyper jump access to the display structure.

The Reset key allows reset following a trip condition.

The Status LED is a single bi-coloured LED that can be viewed some distance from the relay. Status indication is as follows:

MPA Status	LED Colour	LED Flash
OK	Green	4 Hz
Alarm	Red	4 Hz
Trip	Red	1 Hz

The 'Motor Status Page' is the default screen on power up and shows the current status of the MPA Protection Relay. A one-line status message is displayed and if more than one message is active the display cycles through all active messages at 1 second intervals.

4.1 Trip/Status Messages

The following table (Table 4.1) shows a list of the twenty-three status messages and the category (type) of the messages. Messages are cleared according to their message category.

Type 1: Messages are triggered by their respective functions and cleared by operating the <RESET> key/digital input.

Type 2: Messages are triggered and cleared automatically.

Type 3: Messages are triggered by their respective trip functions. Messages are cleared by closing the lock input, and then operating the <RESET> key/digital input, and then releasing the lock input.

Message and Type		Comment
`Motor O/L Trip`	1/2	Over Current Function Tripped
`Short Cct Trip`	3	Short Circuit Function Tripped
`Cur. bal. Trip`	1	Phase Current Balance Function Tripped
`Earth Leak Trip`	1	Earth Leakage Function Tripped
`Residual I Trip`	1	Residual Current Function Tripped
`Thermistor Trip`	1	Thermistor PTC Function Tripped
`Under Volts Trip`	1	Under Volts Function Tripped
`MPA Memory Error`	1	Corrupted memory in relay's stored settings
`RTD Group1 Trip`	1	RTD Group 1 Function Tripped
`RTD Group2 Trip`	1	RTD Group 2 Function Tripped
`Motor Cont. Fail`	1	Main Contactor Fail Function Tripped
`Insulat.Test Trip`	1	Insulation Test Function Tripped
`High Cur. Alarm`	2	Phase current above set threshold level
`Over Load Alarm`	2	Thermal Accumulator above set threshold level
`Under Cur. Alarm`	2	Phase current below set threshold level
`Earth Leak Alarm`	2	Earth leakage Current is above the set threshold level
`RTD Group1 Alarm`	2	Group 1Temperature above set threshold level
`RTD Group2 Alarm`	2	Group 2 Temperature above set threshold level
`Insulat. Test Alarm`	1/2	Test result at alarm level
`Testing Insulat.`	2	In process of Insulation Test
`IT Enable Open`	2	Insulation test disabled.
`Insulat. Test OK`	2	Insulation Test above the set threshold
`Motor Stopped`	2	MCI Open
`Motor Amps:`	2	MCI Closed

Table 4.1

5 Current Related Functions

5.1 Overload Protection

The motor overload function is based on a thermal model of the motor. The three phase currents are squared to provide the I^2R heating input to the motor model. The selected 'Stopped Cooling Ratio' determines the cooling output for the model.

The state of the thermal model is shown by the 'Thermal Accumulator', which can be viewed on the 'Current/Volts Information' level on the display. The thermal accumulator represents the motor temperature. When it reaches 100% a "Motor Overload" trip occurs.

The full load current is selected via the '**I (100%)**' setting (Level 7, Position 1) and can be set between 5.125 A and 640 A in 224 increments as shown in Table 5.1, 'Current Settings' (below).

MPA Full Load Current Selection Table - Amps													
5.125	7.000	10.000	14.00	20.00	28.0	40.0	56	80	110	160	220	320	440
5.250	7.125	10.25	14.25	20.5	28.5	41	57	82	112	164	224	328	448
5.375	7.250	10.50	14.50	21.0	29.0	42	58	84	114	168	228	336	456
5.500	7.375	10.75	14.75	21.5	29.5	43	59	86	116	172	232	344	464
5.625	7.500	11.00	15.00	22.0	30.0	44	60	88	118	176	236	352	472
5.750	7.625	11.25	15.25	22.5	30.5	45	61	90	120	180	240	360	480
5.875	7.750	11.50	15.50	23.0	31.0	46	62	92	122	184	244	368	488
6.000	7.875	11.75	15.75	23.5	31.5	47	63	94	124	188	248	376	496
6.125	8.000	12.00	16.00	24.0	32.0	48	64	96	126	192	252	384	504
6.250	8.500	12.25	17.00	24.5	34.0	49	68	98	128	196	256	392	512
6.375	8.750	12.50	17.50	25.0	35.0	50	70	100	136	200	272	400	544
6.500	9.000	12.75	18.00	25.5	36.0	51	72	102	140	204	280	408	560
6.625	9.250	13.00	18.50	26.0	37.0	52	74	104	144	208	288	416	576
6.750	9.500	13.25	19.00	26.5	38.0	53	76	106	148	212	296	424	592
6.875	9.750	13.50	19.50	27.0	39.0	54	78	108	152	216	304	432	608
		13.75		27.5		55			156		312		624
													640

Table 5.1 Current Settings

The trip time is selected via the '**6xI Trip t**' setting (Level 7, Position 2). It is a function of the current and the selected trip time curve. The drawing 'MPA Motor Overload and Short Circuit Trip Times', **MPAB007**, in Appendix A – Drawings shows the trip time curves.

The fifteen motor overload curves allow trip settings from 3 to 40 seconds at six times FLC and are shown for both cold and hot conditions. The hot curve corresponds to the trip time after the motor has been running at the selected full load current indefinitely.

The trip time can be calculated as follows:

$$Trip\ Time = C \times 31.53 \times \ln\left[\frac{I^2 - \frac{1.1238A\%}{100}}{I^2 - 1.1238}\right]$$

Where:

C = Curve Selected

I = Current (FLC = 1)

A% = Initial Thermal Accumulator Value

The motor manufacturer's data should always be consulted to select the appropriate settings for the motor being protected. Typically, the capacity of a cold motor is given at six times its rated current.

The MPA Relay's trip curves can then be used to select the trip time curve, which best suits the motors overload capacity.

The motor overload trip latches once the thermal accumulator reaches 100% and can only be reset once the thermal accumulator falls below a preset value. The pre-set value is selected via the '**O/L Reset**' setting (Level 7, Position 3) and can be set to 30%, 40%, 50%, 60%, 70%, 80%, 90%, A-30%, A-40%, A-50%, A-60%, A-70%, A-80%, and A-90%. The "A"- settings automatically reset a motor overload trip once the thermal accumulator falls below the set value. Otherwise the trip has to be reset manually by pressing the keypad 'RESET' button or activating the 'RESET' digital input once the thermal accumulator has fallen below the set value.

An emergency restart on a hot motor can be achieved by zeroing the thermal accumulator memory. This is done by closing the **E/start** input and **reset** key/digital input simultaneously for 1.5 seconds.

CAUTION! 	**Repeated attempts to restart the motor in this condition may damage the motor.**

The 'Stopped Cooling Ratio' modifies the cooling output of the thermal model when the motor is stopped. This can be used to account for reduced cooling capacity of the motor when it is not running (motor run status monitored via MCI digital input).

The ratio is selected via the '**S-Cool Ratio**' setting (Level 7, Position 4) and is adjustable from 1.0 to 5.0. A cooling multiplier of 1 means the cooling is independent of whether the motor is running or not - e.g. a water-cooled motor. Protection for a fan-cooled motor is based on a setting of 2.5, however, for the best protection consult the motor manufacturer.

5.2 Short Circuit Protection

The short circuit function has a definite time characteristic. If the current exceeds the selected level for the pre-set time then a trip occurs. The short circuit function trips the auxiliary relay. (The AUX relay is normally energised, and drops out when tripped).

The short circuit trip level is selected via the '**SC I Trip**' setting (Level 7, Position 6) and is a multiple of the selected full load current, from 3.0 to 10 times FLC, in steps of 0.5. The trip level may be set to '**off**' to disable the SC protection.

WARNING! 	**Setting the trip level to 'OFF' disables the SC function and is intended to only ever be used with coordinated SC tripping circuit breakers or when the SC function is performed external to the MPA. Use extreme caution when choosing this option.**

The trip time is selected via the '**Sc Trip t**' setting (Level 7, Position 7) and is adjustable from 20 ms to 160 ms. See **Drawing MPAB007**, in Appendix A – Drawings.

To reset the relay following a short circuit trip it is necessary close the lock input, operate the reset key/digital input, and then release the lock input.

5.3 Phase Current Balance

The current balance measurement 'Ib' is displayed on the 'Current/Volts Information' Page, Level 1, Position 1 and is calculated as:

$$I_{bal} = \frac{MAX\ \Delta\ I \times 100\%}{I_{ave}}$$

Where:

I_{ave} = Average of the 3 phase currents

$MAX\ \Delta\ I$ = The maximum deviation of a phase current from the average

Phase current balance protection is selected via the '**I Bal Trip**' setting (Level 7, Position 5).

The trip level is selectable at 5%, 10%, 20%, 50%, and off.

The phase current balance protection is inhibited until the average current exceeds both 20% of the selected full load current and the selected balance trip level.

5.4 Residual Current Signal

The three phase current signals are summed electronically in the MPA to produce a residual current signal that can be used to detect earth fault currents. If the residual current signal exceeds the trip level for the selected trip time, a trip occurs, tripping the MTR relay. The fault is latched.

To reset the relay following a residual current trip, operate the reset key/digital input.

The % residual current is displayed as '**Ir**' on the 'Current/Volts Information' Page, Level 1, Position 2.

The trip level is selected via the '**Ires Trp**' setting (Level 7, Position 14) and is adjustable from 10% to 100% FLC. The trip time is selected via the '**Ir Time**' setting (Level 7, Position 15) and is adjustable from 100 ms to 5 s. Setting the trip level to 'Off' disables this function.

The residual current function can be used even if a core balance toroid is used for earth leakage protection. It can be used to provide some detection of wiring/CT/internal relay faults.

6 Earth Leakage Protection

The earth leakage protection function uses an optional core balance toroid to measure the earth fault current. A definite time operating characteristic is provided with adjustable trip sensitivity and time delay. If the earth leakage signal exceeds the trip level for the selected trip time, a trip occurs, tripping the MTR relay. The fault is latched.

The % leakage current is displayed on the 'Current/Volts Information' Page as '**Ie**' shown as a % of the selected trip level. When the leakage reaches 100% for the selected time delay a trip occurs.

To reset the relay following an earth leakage trip, operate the reset key/digital input.

The trip level is selected via the '**EL**:' setting (Level 7, Position 11) and is adjustable between 0.001 A to 0.005 A x CT ratio. (e.g. with 100:1 CT, trip 100-500 mA).

The time delay is selected via the '**EL Time**' setting. Settings are Instantaneous and are adjustable between 55 ms and 475 ms. Setting the trip level to 'Off' will disable this function.

For alarm functions see '**MPA Alarm Functions**', Section 15.

7 Motor Contactor Fail Protection

The status of the motor contactor is monitored via the 'MCI' digital input. If the MPA trips its MTR relay then it expects to see the MCI open. Failure to open within 1 second will cause a 'Motor Contactor Fail' trip that operates the AUX relay. The AUX relay should be arranged to provide backup tripping of the motor, usually through a main circuit breaker.

To reset the relay following a motor contact failure trip, operate the reset key/digital input.

The status of the MCI input can be viewed on the 'MPA I/O Status Information' Page, Level 5, Position 1.

8 Metering

The MPA Motor Protection relay provides the following information:

- Phase Currents
- Current Balance
- % Residual Current
- % Leakage Current
- Trip Accumulator (thermal capacity indicating how close to a trip condition)
- Result of Insulation Test (MPA-I option)
- % Phase voltage (MPA-I option)
- Stator Temperature (MPA-M option)
- Bearing Temperature (MPA-M option)

9 Insulation Test

The optional Insulation Test Module (MPA-I) allows the insulation resistance of 415 V motors and/or installations to be tested with 500 VDC to earth. Selectable trip and alarm thresholds can be triggered if the resistance to earth is too low. This test can only be performed when the motor is stopped (MCI open). The external 'Insulation Test Enable' (ITE) terminals must also be bridged to allow a test to be performed.

An insulation test (IT) is activated by the option selected by the '**ITst Mode**' setting (Level 7, Position 16). The options are:

Setting	Comment
Di1	Di1 digital input activates IT
Key	Keyboard Test Key activates IT
Di1/Key	Either one of the above activate IT
Off	IT disabled

The '**ITstatus**' is shown on the 'Insulation Test Information' Page, Level 4, Position 1 and indicates the following:

Status	Comment
`No ITM`	IT Module not installed
`Mtr Run`	Motor Running (IT Disabled)
`Enable?`	IT Module installed but Enable Input (ITE) not bridged
`Test?`	Ready to test, waiting IT input according to 'IT Mode' setting
`Testing`	Test in progress. IT input must remain for three (3) seconds
`Test OK`	IT result was OK, message remains until loss of IT input
`Alarmed`	IT result triggered an alarm, message remains until loss of IT input
`Tripped`	IT result triggered a trip, message remains until trip is reset

The 'testing' phase takes 3 seconds during which time the IT input must remain active in order to obtain a valid result. The last IT result is retained in memory and displayed until a subsequent test or power down.

The measurement range is 125 MΩ down to 0.8 MΩ, with <0.8 MΩ displayed for values less than 0.8 MΩ.

The trip level is selected via the '**ITst Trp**' setting (Level 7, Position 17) and is adjustable between 1.0 MΩ and 100 MΩ.

The alarm level is selected via the '**ITst Alm**' setting (Level 7, Position 18) and is adjustable between 1.0 MΩ and 100 MΩ.

A trip takes priority if both trip and alarm conditions occur as a result of an IT.

IT alarms self-clear when a subsequent IT result is greater than the selected alarm value. They can also be reset manually by operating the reset key/digital input.

IT trips are latched and prevent subsequent IT's until the trip is manually reset by operating the reset key/digital input.

Setting either the '**ITst Trp**' or '**ITst Alm**' setting to 'OFF' disables that function.

10 Under-voltage Trip

The optional Insulation Test Module (MPA-I) allows Under-voltage protection that is enabled as soon as the main contactor is closed (indicated by closing the MCI input). If any of the phase voltages drop below the selected trip setting of the nominal line voltage for 1.5 Seconds then the MTR relay is de-energised.

To reset the relay following an under-voltage trip, operate the reset key/digital input.

The trip level is selected via the '**UV Level**' setting (Level 7, Position 19) and is adjustable from 40% to 95%. Setting the trip level to 'Off' disables this function.

11 PT-100 RTD Temperature Protection

The optional Monitoring Module (MPA-M) allows temperature monitoring of 5 PT-100 RTDs, connected in 3-wire mode. The three-wire connection allows compensation of installation lead resistance. The RTD inputs are configured as 'Group1' RTD's (1, 2 and 3) and 'Group 2' RTD's (4 and 5). Each Group has a separate alarm and trip level. Group 1 (G1) is intended for monitoring stator temperature while group 2 (G2) is intended for bearing temperature.

The Trip levels are selected via the '**RTD G1 T**:' and/or '**RTD G2 T**:' settings (Level 7, Position 20 and 22) and are adjustable from 60°C to 200°C. If the measured value exceeds the trip level for 2 seconds, a trip occurs. Trips are latched, and cannot be reset by the reset/digital input until the temperature falls back below the trip threshold. Setting the trip level to 'Off' disables this function.

The Alarm levels are selected via the '**RTD G1 A**:' and/or '**RTD G2 A**:' settings (Level 7, Position 21 and 23) and are adjustable from 50°C to 200°C. If the measured value exceeds the alarm level for 2 seconds, an alarm occurs. Alarms self clear once the measured value falls below selected value for 2 seconds. Setting the alarm level to 'Off' disables this function.

A trip takes priority if both trip and alarm conditions occur as a result of a RTD's temperature.

The RTD temperatures for group 1 and group 2 can be viewed on the 'Temperature Information' Page, Level 2, Positions 1 and 2 respectively. The measurement range is 0°C to 210°C. Values greater than 210°C represent an error condition as follows:

Error	Comment
246	Error code 246 results if the RTD terminals are left open circuit or the RTD resistance rises above 330 Ω. Unused RTD inputs can be terminated with a 100 Ω resistor (0°C) to avoid the error code.
245	Error code 245 results if the RTD is short-circuited or its resistance falls below 80 Ω.

The RTD's will operate correctly if the combined installation cable resistance to the PT-100 RTD is less than 40 Ω.

12 Analogue Output

The optional Monitoring Module (MPA-M) provides an isolated analogue output configurable as 0-20 mA or 4-20 mA. The output is selected via the '**An OP**:' setting (Level 7, Position 24) to continuously monitor one of the following sections:

- Trip Accumulator (20 mA = 100%)
- Average Current (20 mA = 120%)
- Earth Leakage (20 mA = 100%)
- RTD Temp (0-200 °C) (20 mA = 200°C)
- Current Balance (20 mA = 100%)
- Phase Voltage (A phase) (20 mA = 120%)

The analogue output status is shown on the 'MPA I/O Status Information' Page, Level 5, Position 4. The value shown for '**Analog Out**' is related to the analogue output current according to:

$$I\text{out (mA)} = \text{Displayed Value} \times 8.1458 \times 10^{-05}$$

13 Communications

When the MPA is ordered with an optional monitoring module a communications port is provided. This allows for the connection of the MPA to PLC or SCADA systems. Two different monitoring modules are available providing a choice between RS485 Modbus RTU and EtherNet/IP.

With either communications option, the same data is available over the network. See Section 23, '**MPA Communications Address Table**' for accessible data.

13.1 Modbus Communications

The baud rate is selected via the '**Modbus:**' setting (Level 7, Position 25) and is selectable between 1200 and 9600 Baud, with even, odd, or no parity. One stop bit is used in conjunction with parity, while two stop bits are used with no parity.

The half-duplex 3-wire RS485 communications interface allows up to 31 devices to be multi-dropped onto a single master communication line. The MPA's Modbus Slave address is selected via the '**Modbus Ad**:' setting (Level 7, Position 26) and is adjustable between 1 and 31.

13.1.1 Modbus Commands

The following Modbus commands are supported:

Modbus CMD	Comment
03	Read Holding Registers
04	Read Input Registers
06	Store Single Register
16	Store Multiple Registers

Valid read registers are in the range from 1 to 96. An attempt to read a register outside this range will result in an exception scan. Currently, only the first 64 registers contain valid data. The range from 65 to 96 is for future expansion The range from 65 to 96 are also write addresses, the only active write address is 65 which is folded back to the read only address 20.

Supported Modbus exception responses are:

Modbus Exception	Comment
01	Illegal Function
02	Illegal Data Address
03	Illegal Data Value

13.1.2 Modbus Status

The MPA Modbus status is shown on the 'MPA I/O Status Information' Page, Level 5, Position 4 and indicates the following:

Status	Comment
No Opt Card	No monitoring card installed
No Mbus RxD	Monitoring card installed, but there has not been a valid Modbus transaction in the last 30 seconds
Online…OK	Monitoring card installed, and a valid Modbus transaction has occurred in the last 30 seconds

13.2 EtherNet/IP Communications

13.2.1 Ethernet Network Configuration

The Ethernet connection allows for the setting of the MPA's IP Address, Default Gateway Address and Subnet Mask. The IP Address can only be set statically using the MPA configuration menu. Dynamic address configuration protocols such as DHCP or BOOTP cannot be used.

Both the IP address and the default gateway are set using four individual parameters; one for each byte of the address. The subnet mask is set as a single number between 0 and 32. This number is the number of bits used in the subnet mask.

Example configuration:

IP Address: 192.168.10.25
Default Gateway: 192.168.11.254
Subnet Mask: 255.255.0.0

IP Address			
IP Addr 3	IP Addr 2	IP Addr 1	IP Addr 0
192	168	10	25

Gateway			
Gateway 3	Gateway 2	Gateway 1	Gateway 0
192	168	11	254

SubnetMsk
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13.2.2 EtherNet/IP Settings

The MPA provides process data to the originator of an EtherNet/IP connection using I/O messaging. The connection can be established by creating a generic Ethernet Module and setting the following parameters:

	Assembly Instance	Size
Input	101	65
Output	102	1
Configuration	128	0

Comms Format:	Data - INT
Requested Packet Interval:	> 150 ms

The MPA data should be available as Input data once an EtherNet/IP Connection has been established.

14 Energy Storage Module

The Energy Storage Module (MPA-E) allows the MPA Relay to function normally for a period of two (2) seconds during an extreme power dip or power loss.

15 MPA Alarm Functions

The MPA has several standard alarm functions. If any are triggered, the Alarm Relay (ALM) picks up. Each has a selectable alarm level, and can be disabled. Generally the alarms are self-resetting once the alarm condition is removed. Optional modules MPA-I and M contain alarm settings for Insulation Test and Temperature Monitoring.

15.1 High Current Alarm:

This is triggered by the phase currents exceeding the selected threshold. It is selected via the '**HI I Alarm:**' setting (Level 7, Position 8) and is adjustable from 100% to 600% FLC. The highest of the three phase currents is used. Time delay = 1 sec. Setting the alarm level to 'Off' disables this function.

15.2 Overload Alarm:

This is triggered by the thermal accumulator exceeding the selected threshold. It is selected via the '**O/Load Alm:**' setting (Level 7, Position 9) and is adjustable from 50% to 95%. Time delay = 2 Sec. A motor overload trip overrides this alarm. Setting the alarm level to 'Off' disables this function.

15.3 Under Current Alarm:

This is triggered by the phase current falling below the selected threshold. It is selected via the '**LO I Alm:**' setting (Level 7, Position 10) and is adjustable from 32% to 96%. This alarm is only activated when the motor is running (MCI input closed). Time delay = 2 sec. Setting the alarm level to 'Off' disables this function.

15.4 Earth Leakage Alarm:

This is triggered when the earth leakage current exceeds a set level. The alarm level is selected via the '**E/L Alarm:**' setting (Level 7, Position 13) and can be set to 20%, 50%, and 80%. The earth leakage alarm has a time delay of 1 second and auto resets when the earth leakage current falls below the selected level. There is also a special setting called EL-T which causes the alarm relay to activate whenever the earth leakage trip activates, i.e. the earth leakage alarm bit follows the earth leakage trip bit. Setting the alarm level to 'Off' disables this function.

16 Adjustable Settings

The MPA settings can be reviewed and/or adjusted by selecting the 'MPA Settings Information' Page, Level 7. At this level all the adjustable parameters are listed with their current value.

Although settings are available in both cases, the Modbus settings will not function on a Motor Protection Relay if it is supplied with the Ethernet option, and the Ethernet settings will not function if the relay is supplied with the Modbus option.

16.1 Common Settings

I(100%) =	Sets the basic current range
6xI Trip t:	Selects the overload trip time at six (6) times FLC
O/L Reset:	Selects the reset level as a % of the thermal accumulator
S-Cool Ratio:	Allows the cooling rate of the thermal model to be modified
I Bal Trip:	Selects the current balance trip threshold as a % of FLC
SC I Trip:	Selects the short circuit trip level
SC Trip t:	Selects the trip time for the short circuit function
HI I Alarm:	Selects the high current alarm threshold as a % of FLC
O/Load Alm:	Selects the overload alarm threshold as a % of the thermal accumulator
LO I Alarm:	Selects the low current alarm threshold as a % of FLC
EL:	Selects the sensitivity trip level for the earth leakage protection
EL Time:	Selects the trip time for the earth leakage protection
EL Alarm:	Selects the alarm trip level for the earth leakage protection
Ires Trp:	Selects the residual current trip threshold as a % of FLC
Ir Time:	Selects the trip time for the residual current function
ITst Mode:	Selects the insulation test mode or disables the function
ITst Trp:	Selects the insulation test trip threshold
ITst Alm:	Selects the insulation test alarm threshold
UV Level:	Selects the under voltage trip threshold as a % of line volts
RTD G1 T:	Selects the temperature trip threshold
RTD G1 A:	Selects the temperature alarm threshold
RTD G2 T:	Selects the temperature trip threshold
RTD G2 A:	Selects the temperature alarm threshold
An OP:	Selects the section to be monitored

16.2 Modbus Settings

Modbus:	Selects the communications baud rate
Modbus Ad:	Selects the Modbus Slave address

16.3 Ethernet Settings

IP Addr 3
IP Addr 2
IP Addr 1
IP Addr 0

} These four parameters are combined to create the 32 bit IP address for the device

Gateway 3
Gateway 2
Gateway 1
Gateway 0

} These four parameters are combined to create the 32 bit default Gateway address for the device

Subnet Mask Sets the number of bits (0-32) used to form the Subnet Mask for the device.

16.4 Changing Settings

To change a value of a particular parameter the following steps are required:

a) Ensure the motor is stopped.

b) Using the **right** arrow key display the parameter that has to be changed.

c) Ensure the '**Lock**' input is closed.

d) Press the **ENT** key. The following warning message will be displayed on the top line of the display 'Change? Ent (ESC)'.

e) Press the **ENT** key. The top line of the display will change to ' ← → Ent (ESC)'.

f) Use the **left** and **right** arrows to step through the allowable values until the desired new setting is displayed. Note that holding the keys in will cause the values to scroll through quickly.

g) When the desired value is displayed press the **ENT** key. The top line of the display will change to 'Confirm Save:Ent'.

h) Press the **ENT** key. The top line of the display will change to ' Saving ....'

i) The top line of the display will change to 'Stored Value'. This completes the setting process. Review the new value to confirm the correct setting.

j) Open the lock input.

If the **ESC** key is operated at any stage during the procedure, the modifying sequence is aborted and the setting reverts to its previously stored value.

17 Digital Inputs

The MPA provides six voltage free digital inputs for correct operation. To activate an input a connection needs to be made from '+DiPwr' terminal to the respective digital input's terminal. The status of each input can be viewed on the 'MPA I/O Status Information' Page, Level 5, Position 2 and 3.

The function of each input is as follows:

Lock: The lock input needs to be closed while changes are being made to the relay settings. If the lock input is not closed then the settings cannot be changed. The lock input must also be closed to reset a short circuit trip.

Reset: The reset digital input performs the same function as the keyboard reset allowing for external/remote resetting of trips. To reset a trip an open-to-close transition on the reset input (or reset key) is required.

Estart: The Emergency Start input can be used to reset the thermal memory to allow an emergency re-start. To perform a reset, the motor must be stopped (MCI open) and both the reset key **and** the Estart key must be held closed for 1.5 seconds. This will reset the 'Thermal Accumulator' and allow the motor to be started immediately.

MCI: The Motor Contactor Interlock input provides the MPA Relay with the status of the motor contactor. Its status is used by the thermal modelling through the 'Cooling Multiplier' and also provides the basis for Motor Contactor Fail (MCF) monitoring.

Di1: This is an auxiliary digital input. It can be configured to activate an Insulation Test (IT).

PTC: This input is designed for connection to a Positive Temperature Coefficient semiconductor thermistor. The nominal operating threshold is 2.2 k. (The PTC resistance needs to be below this level for normal operation). A PTC trip will be triggered and latched if the PTC resistance rises above this level.

18 Output Relays

The MPA provides three relay outputs for correct operation. All relay contacts are rated at 5 A/250 VAC.

MTR: (Main Trip Relay). This relay energizes when there are no trips, and drops out whenever a trip occurs. A normally open and a change over set of contacts are provided.

ALM: (Alarm Relay). This relay energizes whenever there are alarms active and drops out when all alarms are clear. One normally open contact is provided.

AUX: (Auxiliary Relay). This relay is normally energized and drops out if there is a short circuit trip or a motor contactor fail trip. One normally open contact is provided.

The status of each relay can be viewed on the 'MPA I/O Status Information' Page, Level 5, Position1.

19 Event Log

The MPA provides a real time clock/calendar, which combines with non-volatile memory to provide a data logging feature. This log sequentially records the time, date and details of the most recent event. A chronological list of the last 50 events is stored on a first-in first-out basis.
Use the right and left arrow keys to scroll the event log.

An example typical display is as follows:

```
LOG 10: EL TRIP
MO 15/05 09:46:21
```

This log indicates that an earth leakage fault caused a trip condition on Monday, 15 May at 9.46am. Log 10 indicates that it is the 10th log in the list. **Log 1 is always the most recent event**. Each time a new log is recorded, the 50th log is removed from the list.

The following events are logged:

Log	Comment
'Power Up'	Control power to MPA was applied
'EL 'Trip'	Earth Leakage Trip condition.
'O/L Alarm'	Thermal Accumulator has exceeded the set threshold
'H/Cur.Alm'	Phase Currents above set threshold
'OC Trip'	Overload Trip condition
'SC Trip'	Short Circuit Trip condition
'Mot.Con.F'	Motor Contactor Fail
'uLoad Alm'	Phase Currents below set threshold
'RTDg1 Trp'	RTD Group 1 Trip condition
'RTDg2 Trp'	RTD Group 2 Trip condition
'ITst OK'	Insulation Test Result OK
'RESET'	Trip conditions were Reset
'Setup Mod'	MPA setting was modified
'Pwr Down'	Control power to MPA was lost
'Mem.ERROR'	MPA non-volatile memory has been corrupted
'uVOLT Trp'	Under Volts Trip condition
'µ- P reset'	Internal microprocessor reset
'I bal-Trp'	Current Balance Trip condition
'Tmem Loss'	The thermal memory data has been corrupted
'Ires Trip'	Residual E/L Trip condition
'PTC Trip'	Thermistor Trip condition
'RTDg1 Alm'	RTD Group 1 Alarm condition
'RTDg2 Alm'	RTD Group 2 Alarm condition
'T-mem Rst'	Thermal memory has been manually reset to zero
'ITst Trip'	Insulation test result is below the set threshold

20 Advanced Display Operation

The MPA display is structured to allow experienced users quicker access to information. This is achieved by the use of the '**ENT**' and '**ESC**' keys to move quickly around the display structure.

Operating the **ENT** key causes the current display position to be 'remembered', and then a jump occurs to a new display position. The **ESC** key reverses this (or jumps back to the top left position).

If the **ENT** key is pressed while the display is on a position where there is information related to relay settings then the display will jump to the related 'MPA Settings' Page. For example, if the display is showing the 3 phase currents (Level 1, Position 1 on the display), then pressing the **ENT** key will cause the display to jump to the position where the full load current level is selected. The current level can then be adjusted (or just reviewed). Once this is done pressing the **ESC** key will return the display to the original display position. In this way the **ENT** and **ESC** keys can be used to toggle back and forth between the two displays. Note that the display can be moved **left** or **right** on the setup level to change a parameter. Once the parameter has been changed the operation of the **ESC** key will still return to the original display. Pressing the **ENT** key again will cause a jump back to the new position on the setup level.

Pressing the **ESC** key when there has been no return position recorded will return the display to the top left 'Motor Status' Page. Pressing the **ENT** key after 'escaping' to the top will cause the display to return to the previous position.

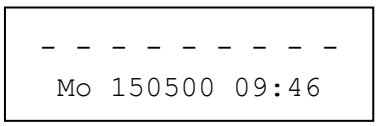
If the **ENT** key was pressed on the default 'Motor Status' Page when there has been no return position 'remembered', the display will jump down to the settings level.

To allow rapid movement through the displays when viewing/adjusting the settings, holding the **left** or **right** arrow keys for > 0.5 Sec will cause faster incrementing through the values.

21 Time & Date

The MPA real time clock/calendar can be adjusted by carrying out the following procedure:

1) Select the 'Date and Time Information' Page, Level 6, Position 1 to display the Day, Month, Year, Hours and Minutes. Press the right arrow to display:



2) Press the ENT key. A 'v' will appear in the top line above the minute section. This indicates the number to be changed.
3) Use the left and right arrow keys to move the 'v' to the desired Position.
4) Press the **ENT** key. The 'v' now changes to a '?' The right arrow key is used to increment the allowable values, once the desired value is obtained, press the **ENT** key again. The '?' returns to a 'v'.
5) Repeat steps 3 and 4 until the correct time and date are displayed.
6) With the 'v' showing press the reset button. The 'v' then changes to 'E'. (This is a prompt to press the **ENT** key).
7) Press the **ENT** key. At that instant, the seconds are zeroed and the selected time/date information is transferred to the internal clock.

If the battery voltage is low the time will zero and the date will reset to 1st January on power up.

	The date and time is used only to time stamp the events in the log (which are recorded sequentially regardless of the date/time). The time function also allows the thermal model to continue to simulate the motors thermal behaviour when the power is removed from the relay.

22 MPA Specifications

Feature	Details
Auxiliary Supply Volts:	240VAC ± 20%, 50Hz ± 2 Hz or 110VAC ± 20%, 50Hz ± 2 Hz
Earth Leakage Protection:	Trip Setting: 0.001x to 0.005x CT Ratio and 'Off'. Time Delay: 55 ms to 475 ms
Residual Current:	Trip Setting : 10% to 100% FLC and Off Time Delay: 100 ms to 5 Seconds
Overload Protection:	
Current Range:	5.125 to 640 Amps (224 values across the range. Steps of 1.6% - 3%)
6xI Trip Time:	3, 4, 5, 6, 7, 8, 10, 12, 14, 16, 20, 24, 28, 32, 40 Seconds
O/L Reset Level:	30%, 40%, 50%, 60%, 70%, 80% 90%
S-Cool Ratio:	1.0, 1.5, 2.0, 2.5, 3.0, 4.0, 5.0
Current Balance:	
Trip Settings:	5%, 10%, 20%, 50% and Off
Short Circuit Protection:	
Trip Setting:	3.0x to 10.0x FLC 0.5 increments or Off
Trip Time:	20, 40, 60, 80, 100, 120, 160mS
Thermistor Protection	PTC resistor < 2.2 kΩ
Under voltage Protection:	
Trip Setting:	Selectable from 40% to 95% and Off
Trip Time:	Trip delay 1.5 Seconds
Insulation Test:	
Trip Setting:	Selectable from 1.0 to 100 Meg Ohm and Off
RTD Temperature Protection:	
Trip Setting:	Selectable from 60°C to 200°C and Off
Time Delay:	2 Seconds
MPA Alarms:	
High Current:	Selectable from 100% to 600% and Off - Time Delay 1 Second
Low Current:	Selectable from 32% to 96% and Off - Time Delay 2 Seconds
Overload:	Selectable from 50% to 95% and Off - Time Delay 2 Seconds
Under Current:	Selectable from 32% to 96% and Off - Time Delay 2 Seconds
Earth Leakage:	Selectable from 20%, 50%, 80% and Off - Time Delay 1 Second
MPA Optional Module Alarms:	
Insulation Test Alarm:	Selectable from 1.0 to 100 Meg Ohm and Off
RTD, Group1 & 2 Over Temp:	Selectable from 50°C to 200°C and Off
Serial Communications:	
RS485 Communication Port:	Standard Modbus RTU Protocol (MPA is a slave Device). Baud rate 1200, 2400, 4800 and 9600 with even, odd or no parity.
EtherNet/IP	IP address, default gateway and subnet mask are selectable.
Relay Contacts:	
MTR	1 N/0 5A/250VAC 1 C/0 5A/250VAC

Feature	Details
ALM, AUX	1 N/O 5A/250VAC

23 MPA Comms. Address Table

Modbus Address	Description	Bitmask
0 (EtherNet/IP only)	Internal status	
1 Note: Bits set when tripped.	Trip Status 1 Bit0 = Motor O/L Trip Bit1 = Short Cct Trip Bit2 = Cur. Bal. Trip Bit3 = N/A Bit4 = Earth Leak Trip Bit5 = Residual Cur. Trip Bit6 = Thermistor Trip Bit7 = Under Volts Trip	00F7
2 Note: Bits set when tripped.	Trip Status 2 Bit0 = MPA Memory Error Bit1 = RTD Group1 Trip Bit2 = RTD Group2 Trip Bit3 = MCF Bit4 = Insulat.Test Trip Bit5 = N/A Bit6 = N/A Bit7 = N/A	001F
3 Note: Bits set when tripped.	Alarm Status 1 Bit0 = High Cur. Alarm Bit1 = Over Load Alarm Bit2 = N/A Bit3 = Under Cur. Alarm Bit4 = Earth Leakage Alarm Bit5 = N/A Bit6 = RTD Group1 Alarm Bit7 = RTD Group2 Alarm	00CB
4 Note: Bits set when tripped.	Alarm Status 2 Bit0 = Insulat.Test Alarm Bit1 = N/A Bit2 = N/A Bit3 = N/A Bit4 = N/A Bit5 = N/A Bit6 = N/A Bit7 = N/A	0001
5 Note: Bits set when active.	Status Bit0 = Testing Insulat. Bit1 = Insulat. Test Enable Open Bit2 = Insulat. Test OK Bit3 = N/A Bit4 = N/A Bit5 = N/A Bit6 = Motor Stopped Bit7 = Motor Running	00C7
	DELIBERATELY LEFT BLANK	
6 Note: Bits set when energised.	Relay Status Bit0 = Main Trip Relay (MTR) Bit1 = Alarm Relay (ALM) Bit2 = Auxiliary Relay (AUX) Bit3 = Megger Activated Bit4 = N/A Bit5 = N/A Bit6 = N/A Bit7 = N/A	000F
7 Note: Bits set when open.	Digital Inputs Bit0 = Insulat. Test Enable Bit1 = Insulat. Test Fitted Bit2 = Lock Bit3 = Reset Bit4 = Estart Bit5 = MCI Bit6 = Di1 Bit7 = PTC	00FF
8	OC Thermal Accum (0..120%)	00FF
9	RESERVED	0000
10	A Phase Current (0..1000%)	03FF
11	RESERVED	0000
12	B Phase Current (0..1000%)	03FF
13	RESERVED	0000
14	C Phase Current (0..1000%)	03FF
15	RESERVED	0000
16	Residual Current (0..1000%)	03FF
17	E/L Current (0..110%)	00FF
18	Avg. Current (0..250=0..1000%)	00FF
19	Current Balance (0..100%)	00FF
20	Control Byte from modus write address 65	00FF
21 Bits clear when key pressed.	Keyboard Data Bit0 = Up Arrow Bit1 = Left Arrow Bit2 = Enter Key Bit3 = Right Arrow Bit4 = Down Arrow Bit5 = Reset Key Bit6 = Esc Key Bit7 = Test Key	00FF
22	A Phase Voltage (0..120%)	00FF
23	B Phase Voltage (0..120%)	00FF
24	C Phase Voltage (0..120%)	00FF
25	RTD1 Temp (0..210 degC)	00FF
26	RTD2 Temp (0..210 degC)	00FF
27	RTD3 Temp (0..210 degC)	00FF

Modbus Address	Description	Bitmask
28	RTD4 Temp (0..210 degC)	00FF
	DELIBERATELY LEFT BLANK	
29	RTD5 Temp (0..210 degC)	00FF
30	Insulat. Test Result (Meg.ohm) 0 for <0.8 Meg.ohm 1..99 for 0.1 to 9.9 Meg.ohm 100..127 for ---Meg.ohm 138..255 for 10 to 127 Meg.ohm	00FF
31	Analog Output Value 0..255 x 8.1458E-05 gives 0-20.77mA	00FF
32	MPA Version: Reads $69 Hex = 150 for MPA3 V5.4	00FF
33	Option Version- OPTxVy where: x = Top 3 bits (Hardware Ver.) y = Bot 5 bits (Software Ver.)	00FF
34 to 38	N/A	00FF
39	O/L Reset 0 = ???? 1 = 30% 2 = 40% 3 = 50% 4 = 60% 5 = 70% 6 = 80% 7 = 90% 8 = A-30% 9 = A-40% 10 = A-50% 11 = A-60% 12 = A-70% 13 = A-80% 14 = A-90%	00FF
40	E/L Alarm Setting: 0 = ???? 1 = 20% 2 = 50% 3 = 80% 4 = EL-T 5 = Off	00FF
41	FLC Setting (See OC section): 1..32 = 5.125..10.000A 33..64 = 10.25..20.00A 65..96 = 20.5..40.0A 97..128 = 41..80A 129..160 = 82..160A 161..192 = 164..320A 193..224 = 328..640A	00FF
42	6xFLC Trip Time: 0 = ?? 1 = 3s 2 = 4s 3 = 5s 4 = 6s 5 = 7s 6 = 8s 7 = 10s 8 = 12s 9 = 14s 10 = 16s 11 = 20s 12 = 24s 13 = 28s 14 = 32s 15 = 40s	00FF
43	S-Cool Ratio: 0 = ??? 1 = 1.0 2 = 1.5 3 = 2.0 4 = 2.5 5 = 3.0 6 = 4.0 7 = 5.0	00FF
44	I Balance Trip: 0 = ???? 1 = 5% 2 = 10% 3 = 20% 4 = 50% 5 = Off	00FF
45	SC Trip Level (xFLC): 0 = ???? 1 = 3 2 = 3.5 3 = 4 4 = 4.5 5 = 5 6 = 5.5 7 = 6 8 = 6.5 9 = 7 10 = 7.5 11 = 8 12 = 8.5	00FF

Modbus Address	Description	Bitmask
	13 = 9 14 = 9.5 15 = 10 16 = Off	
	DELIBERATELY LEFT BLANK	
46	SC Trip Time: 0 = ???? 1 = 20 ms 2 = 40 ms 3 = 60 ms 4 = 80 ms 5 = 100 ms 6 = 120 ms 7 = 160 ms	00FF
47	High I Alarm (%FLC): 0 = ??? 1 = 100% 2 = 108% 3 = 120% 4 = 140% 5 = 160% 6 = 200% 7 = 240% 8 = 280% 9 = 320% 10 = 360% 11 = 400% 12 = 500% 13 = 600% 14 = OFF	00FF
48	O/Load Alarm: 0 = ??? 1 = 50% 2 = 60% 3 = 70% 4 = 75% 5 = 80% 6 = 85% 7 = 90% 8 = 95% 9 = OFF	00FF
49	Low I Alarm: 0 = ??? 1 = 32% 2 = 40% 3 = 48% 4 = 56% 5 = 64% 6 = 72%	00FF
	7 = 80% 8 = 88% 9 = 96% 10 = OFF	
50	*EL trip Level (xCTRatio):* *0 = ???* *1 = 0.001* *2 = 0.002* *3 = 0.003* *4 = 0.004* *5 = 0.005* *6 = OFF*	00FF
51	EL Trip Time: 0 = ??? ms 1 = 55 ms 2 = 75 ms 3 = 95 ms 4 = 115 ms 5 = 155 ms 6 = 195 ms 7 = 235 ms 8 = 275 ms 9 = 315 ms 10 = 355 ms 11 = 395 ms 12 = 435 ms 13 = 475 ms	00FF
52	Ires Trip Level (%FLC): 0 = ??? 1 = 10% 2 = 20% 3 = 30% 4 = 40% 5 = 50% 6 = 60% 7 = 70% 8 = 80% 9 = 90% 10 = 100% 11 = OFF	00FF
53	Ires Trip Time: 0 = ??? 1 = 100 ms 2 = 200 ms 3 = 500 ms 4 = 1.0 Sec 5 = 2.0 Sec 6 = 3.0 Sec 7 = 5.0 Sec	00FF
54	Insulat. Test Mode: 0 = ?????	00FF

Modbus Address	Description	Bitmask
	1 = Di1 2 = Key 3 = Di1/K 4 = OFF	
55	Insulat. Test Trip (Meg.ohm): 0 = ??? 1 = 1.0 2 = 1.5 3 = 2.0 4 = 3.0 5 = 5.0 6 = 7.5 7 = 10 8 = 15 9 = 20 10 = 30 11 = 50 12 = 75 13 = 100 14 = OFF	00FF
56	Insulat. Test Alarm (Meg.ohm): 0 = ??? 1 = 1.0 2 = 1.5 3 = 2.0 4 = 3.0 5 = 5.0 6 = 7.5 7 = 10 8 = 15 9 = 20 10 = 30 11 = 50 12 = 75 13 = 100 14 = OFF	00FF
57	UV Level : 0 = ??? 1 = 40% 2 = 50% 3 = 60% 4 = 70% 5 = 75% 6 = 80% 7 = 85% 8 = 90% 9 = 95% 10 = OFF	00FF

Modbus Address	Description	Bitmask
	DELIBERATELY LEFT BLANK	
58	RTD G1 Trip (deg.C): 0 = ??? 1 = 60 2 = 70 3 = 80 4 = 100 5 = 120 6 = 140 7 = 160 8 = 180 9 = 200 10 = OFF	00FF
59	RTD G1 Alarm (deg.C): 0 = ???? 1 = 50 2 = 60 3 = 70 4 = 80 5 = 100 6 = 120 7 = 140 8 = 160 9 = 180 10 = 200 11 = OFF	00FF
60	RTD G2 Trip (deg.C): 0 = ???? 1 = 60 2 = 70 3 = 80 4 = 100 5 = 120 6 = 140 7 = 160 8 = 180 9 = 200 10 = OFF	00FF
	DELIBERATELY LEFT BLANK	

Modbus Address	Description	Bitmask
61	RTD G2 Alarm (deg.C): 0 = ???? 1 = 50 2 = 60 3 = 70 4 = 80 5 = 100 6 = 120 7 = 140 8 = 160 9 = 180 10 = 200 11 = OFF	00FF
62	Analog Output Mode: 0 = ??? 1 = O/L 0-20mA 2 = Cur 0-20mA 3 = Iel 0-20mA 4 = RTD 0-20mA 5 = Va 0-20mA 6 = O/L 4-20mA 7 = Cur 4-20mA 8 = Iel 4-20mA 9 = RTD 4-20mA 10 = Va 4-20mA	00FF
63	Modbus RTU Coms Mode: 0 = ??? 1 = 1200n 2 = 1200e 3 = 1200o 4 = 2400n 5 = 2400e 6 = 2400o 7 = 4800n 8 = 4800e 9 = 4800o 10 = 9600n 11 = 9600e 12 = 9600o	00FF
64	Modbus Address: 0=??, 1..31	00FF

Notes:

1) MPA is a Modbus Slave RTU device
2) Supported Modbus Commands:
   - 03: Read Set points &Actual Values
   - 04: Read Set points &Actual Values
   - 06: Store Single Set point (See note 5)
   - 16: Stores Multiple Set points (See Note 5)
3) Supported Modbus Exception Responses:
   - 01: Illegal Function
   - 02: Illegal Data Address
   - 03: Illegal Data Value
4) Read Address space is 0001 to 0064
5) Write Address:

   Write Address support for address 0065-0096.

   The only write address is 0065.

   Data written to this location is folded back to output address 0020.

24 Maintenance & Disposal

24.1 Equipment Maintenance

WARNING! 	**The MPA has no user serviceable parts. All repairs must be carried out by Ampcontrol personnel only. If a fault develops return the MPA3 to Ampcontrol for repair. It is essential that no attempt be made to repair the MPA3 as any attempt to dismantle or repair the MPA3 can seriously compromise the safety of the unit and the consequence can be fatal.**

The MPA3 V5 Motor Protection Relay does not have any customer serviceable parts and is not provided with any user adjustments.

24.2 Disposal of System Parts

	The electronic equipment discussed in this manual must not be treated as general waste. By ensuring that this product is disposed of correctly you will be helping to prevent potentially negative consequences for the environment and human health which could otherwise be caused by incorrect waste handling of this product.

25 Equipment List

25.1 Base Models and Options Part Nos.

MODEL DESCRIPTION	Auxiliary Supply Volts	Extended Service Motor	Optional Monitoring Modules		Serial Communications Option		PART NUMBER
			Insulation Test	Over-Temp	EtherNet/IP	RS485 Modbus	
MPA3V05.4 Std/110	110	X	X	X	X	X	120405
MPA3V05.4 Std/240	240	X	X	X	X	X	120228
MPA3V05.4 Std/E240	240	✓	X	X	X	X	120367
MPA3V05.4 I/110	110	X	✓	X	X	✓	120224
MPA3V05.4 M/110	110	X	X	✓	X	✓	120404
MPA3V05.4 M/240	240	X	X	✓	X	✓	120229
MPA3V05.4 M/E240	240	✓	X	✓	X	✓	120370
MPA3V05.4 IM/110	110	X	✓	✓	X	✓	120403
MPA3V05.4 IM/240	240	X	✓	✓	X	✓	120230
MPA3V05.4 IME/110	110	✓	✓	✓	X	✓	121529
MPA3V05.4 IM/E240	240	✓	✓	✓	X	✓	120372
MPA3V05.4 IM(e)/110	110	X	✓	✓	✓	X	143093
MPA3V05.4 IM(e)/240	240	X	✓	✓	✓	X	143094

Each Relay is supplied complete with the required Phase Current Transformers

25.2 Miscellaneous Extras

101272 1000/1 45mm ID Current Transformers (3 Required)

101658 Toroid 60 mm ID
115430 Toroid 85 mm ID
101656 Toroid 112 mm ID
} Earth leakage Toroid to be specified at time of order placement

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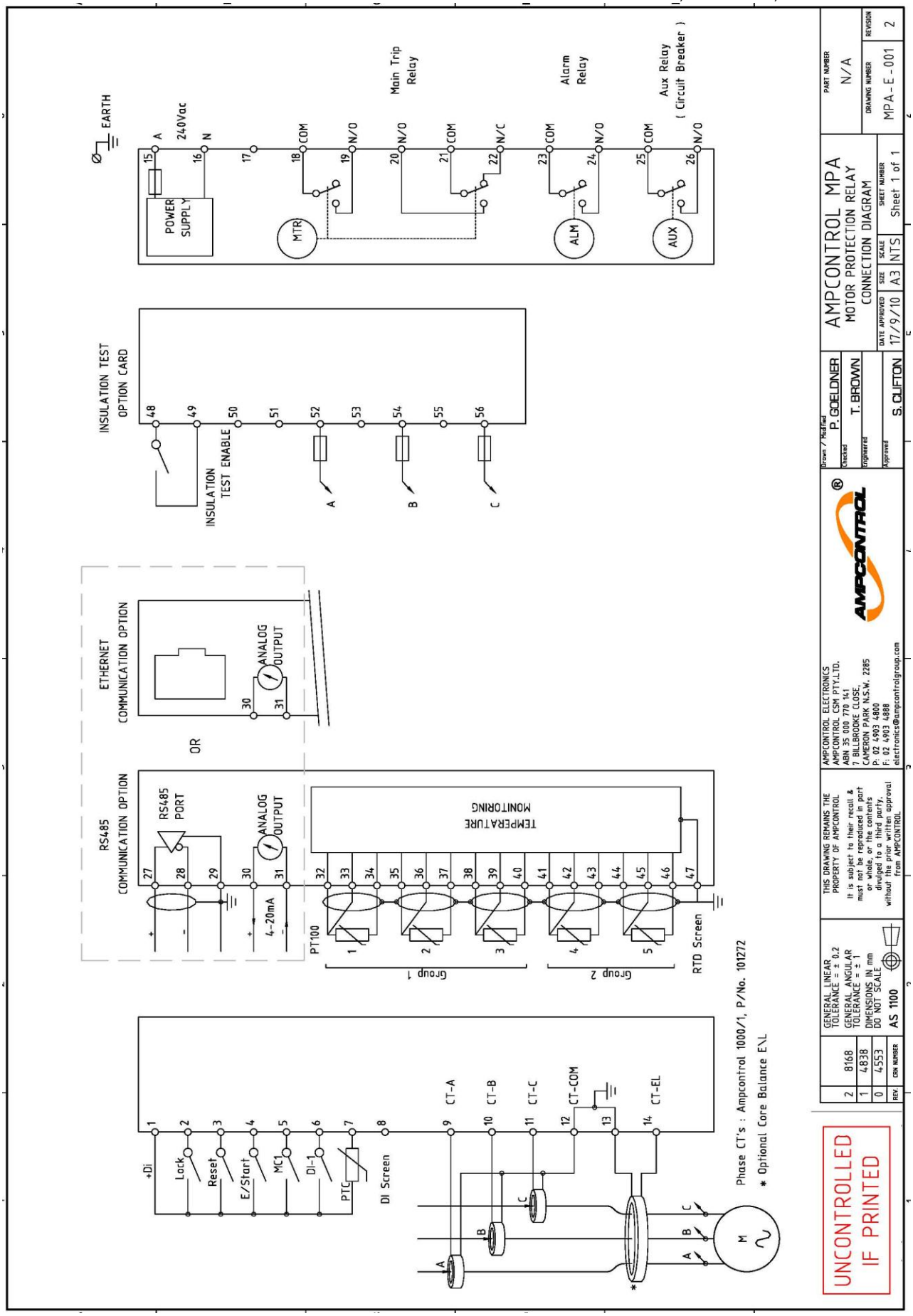
Appendix A – Drawings

Drawing Number	Description
MPAE001	Connection Diagram
MPAB003	MPA Display Map
MPAB007	Motor Overload and Short Circuit Curves
MPAA007	Case Dimensions

The drawings appear in the following pages in the same order in which they are listed in the table above.

If this document is being read via a computer the hyper links may be used (Press control and click on the drawing number to go to that drawing).


EARTH
240Vac
POWER SUPPLY
Main Trip Relay
Alarm Relay
Aux Relay (Circuit Breaker)
MTR
ALM
AUX
INSULATION TEST OPTION CARD
INSULATION TEST ENABLE
ETHERNET COMMUNICATION OPTION
ANALOG OUTPUT
OR
RS485 COMMUNICATION OPTION
RS485 PORT
ANALOG OUTPUT
4-20mA
TEMPERATURE MONITORING
PT100
RTD Screen
Group 1
Group 2
+Di
Lock
Reset
E/Start
MC1
DI-1
PTC
DI Screen
CT-A
CT-B
CT-C
CT-COM
CT-EL
Phase CT's : Ampcontrol 1000/1, P/No. 101272
* Optional Core Balance E\L
AMPCONTROL MPA
MOTOR PROTECTION RELAY
CONNECTION DIAGRAM
MPA-E-001
Sheet 1 of 1
P. GOELDNER
T. BROWN
S. CLIFTON
17/9/10
AMPCONTROL ELECTRONICS
AMPCONTROL CSM PTY.LTD.
ABN 35 000 770 141
7 BILLBROOKE CLOSE,
CAMERON PARK N.S.W. 2285
P: 02 4903 4800
F: 02 4903 4888
electronics@ampcontrolgroup.com
THIS DRAWING REMAINS THE PROPERTY OF AMPCONTROL
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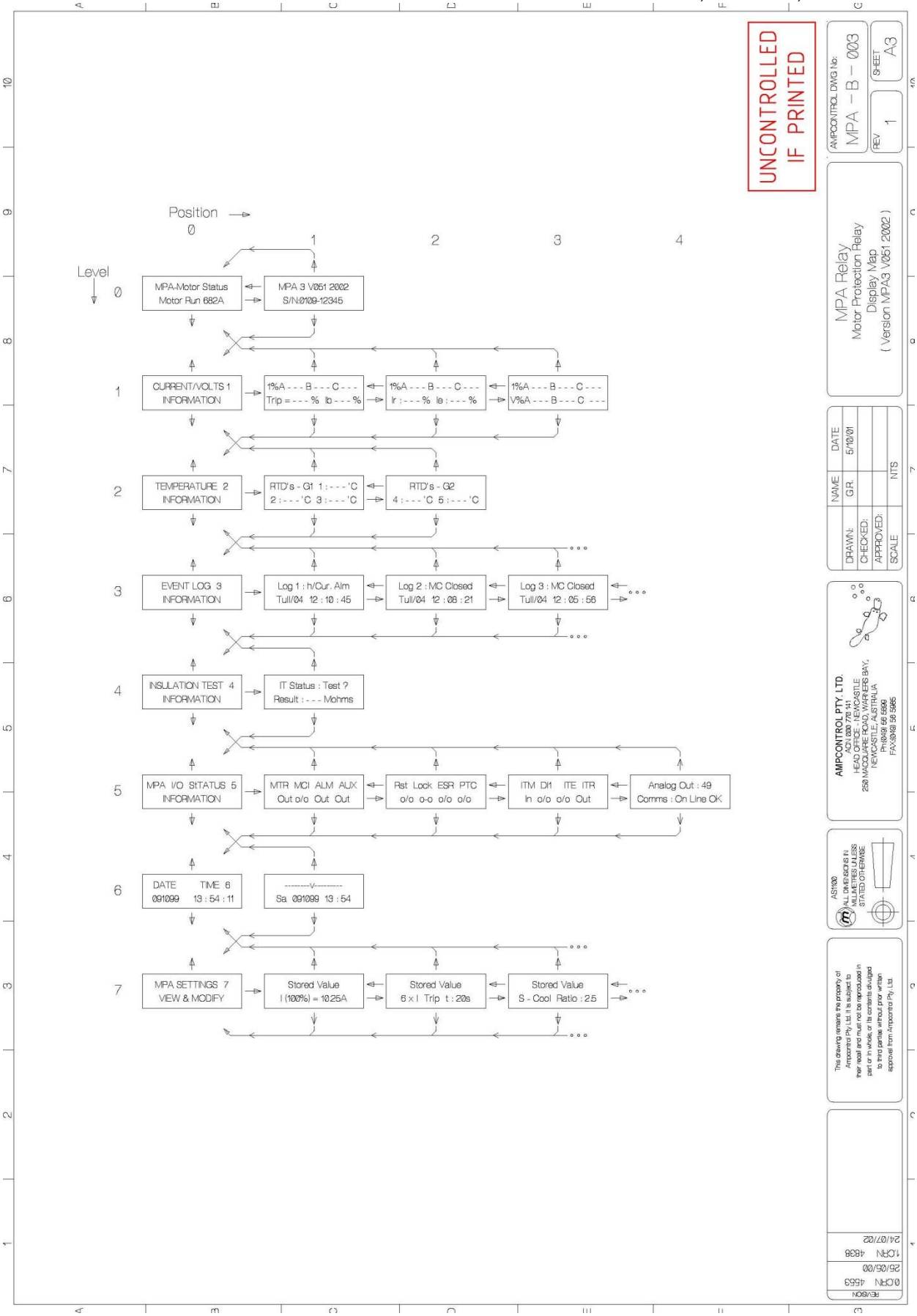
GENERAL LINEAR TOLERANCE = ± 0.2
GENERAL ANGULAR TOLERANCE = ± 1
DIMENSIONS IN mm DO NOT SCALE
AS 1100
UNCONTROLLED IF PRINTED


UNCONTROLLED IF PRINTED
Position
0
1
2
3
4
Level
0
MPA-Motor Status Motor Run 682A
MPA 3 V051 2002 S/N:0109-12345
1
CURRENT/VOLTS 1 INFORMATION
1%A - - - B - - - C - - - Trip = - - - % Io - - - %
1%A - - - B - - - C - - - Ir : - - - % Ie : - - - %
1%A - - - B - - - C - - - V%A - - - B - - - C - - -
2
TEMPERATURE 2 INFORMATION
RTD's - G1 1 : - - - 'C 2 : - - - 'C 3 : - - - 'C
RTD's - G2 4 : - - - 'C 5 : - - - 'C
3
EVENT LOG 3 INFORMATION
Log 1 : h/Cur. Alm Tue//04 12 : 10 : 45
Log 2 : MC Closed Tue//04 12 : 08 : 21
Log 3 : MC Closed Tue//04 12 : 05 : 56
4
INSULATION TEST 4 INFORMATION
IT Status : Test ? Result : - - - Mohms
5
MPA I/O STATUS 5 INFORMATION
MTR MCI ALM AUX Out o/o Out Out
Rst Lock ESR PTC o/o o-o o/o o/o
ITM DI1 ITE ITR In o/o o/o Out
Analog Out : 49 Comms : On Line OK
6
DATE TIME 6 091099 13 : 54 : 11
---------V--------- Sa 091099 13 : 54
7
MPA SETTINGS 7 VIEW & MODIFY
Stored Value I (100%) = 1025A
Stored Value 6 x I Trip t : 20s
Stored Value S - Cool Ratio : 25
MPA Relay Motor Protection Relay Display Map (Version MPA3 V051 2002)
AMPCONTROL DWG No: MPA – B – 003
REV 1
SHEET A3
DRAWN: NAME: DATE
CHECKED: GR. 5/10/01
APPROVED:
SCALE NTS
AMPCONTROL PTY. LTD.
ACN 000 778 141
HEAD OFFICE - NEWCASTLE
259 MACQUARIE ROAD, WARNERS BAY,
NEWCASTLE, AUSTRALIA
Ph:(049) 56 5999
FAX:(049) 56 5985
AS1100
ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE
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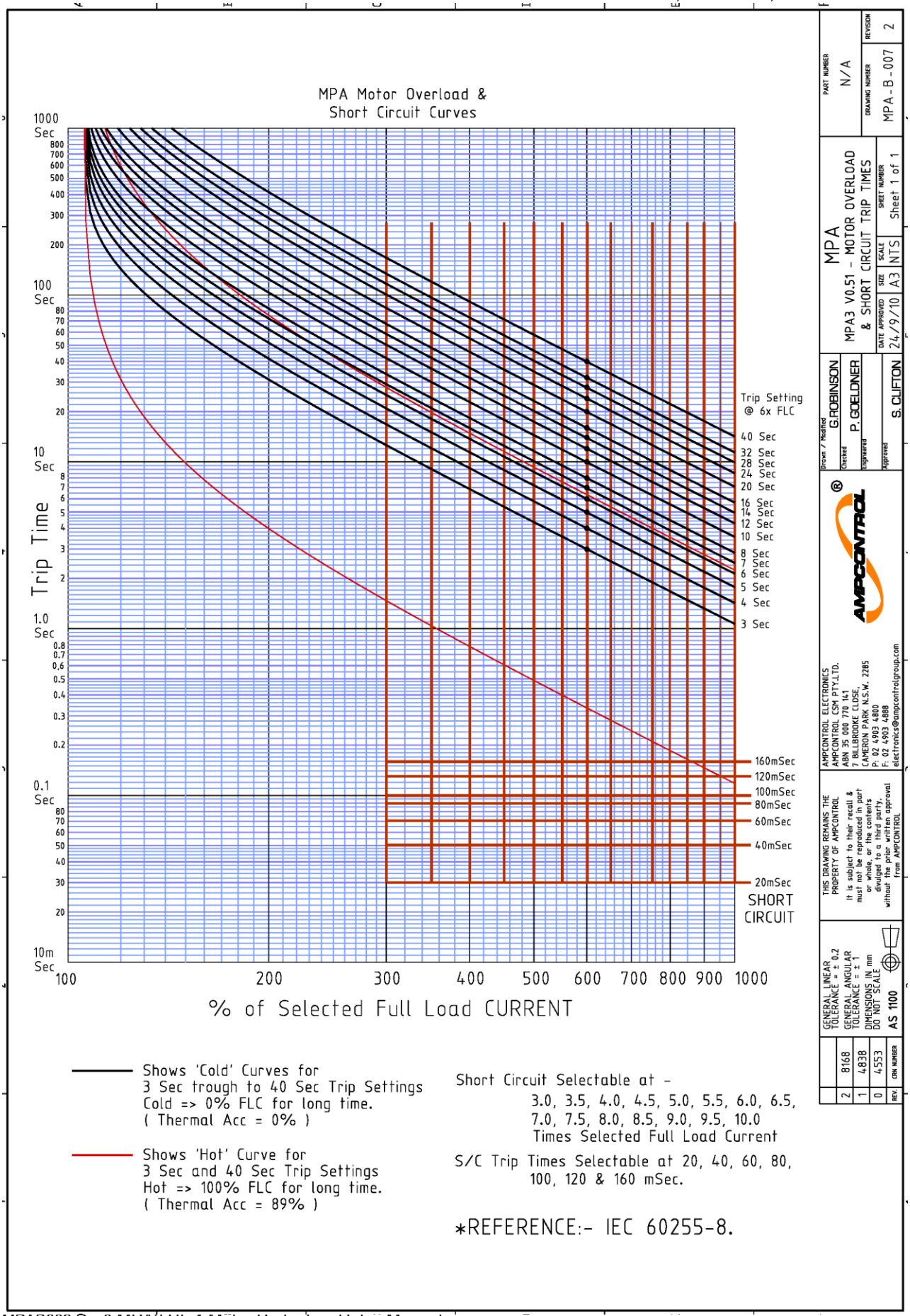
REVISION
0.CRN 4553 26/05/00
1.CRN 4838 24/07/02


MPA Motor Overload &
Short Circuit Curves
Trip Time
1000 Sec
100 Sec
10 Sec
1.0 Sec
0.1 Sec
10m Sec
Trip Setting @ 6x FLC
40 Sec
32 Sec
28 Sec
24 Sec
20 Sec
16 Sec
14 Sec
12 Sec
10 Sec
8 Sec
7 Sec
6 Sec
5 Sec
4 Sec
3 Sec
160mSec
120mSec
100mSec
80mSec
60mSec
40mSec
20mSec
SHORT CIRCUIT
100
200
300
400
500
600
700
800
900
1000
% of Selected Full Load CURRENT
Shows 'Cold' Curves for
3 Sec trough to 40 Sec Trip Settings
Cold => 0% FLC for long time.
(Thermal Acc = 0%)
Shows 'Hot' Curve for
3 Sec and 40 Sec Trip Settings
Hot => 100% FLC for long time.
(Thermal Acc = 89%)
Short Circuit Selectable at -
3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5,
7.0, 7.5, 8.0, 8.5, 9.0, 9.5, 10.0
Times Selected Full Load Current
S/C Trip Times Selectable at 20, 40, 60, 80,
100, 120 & 160 mSec.
*REFERENCE:- IEC 60255-8.
PART NUMBER N/A
DRAWING NUMBER MPA-B-007
REVISION 2
MPA
MPA3 V0.51 - MOTOR OVERLOAD & SHORT CIRCUIT TRIP TIMES
DATE APPROVED 24/9/10
SIZE A3
SCALE NTS
SHEET NUMBER Sheet 1 of 1
Drawn / Modified G.ROBINSON
Checked P.GOELDNER
Engineered
Approved S.CLIFTON
AMPCONTROL ELECTRONICS
AMPCONTROL CSM PTY.LTD.
ABN 35 000 770 141
7 BILLBROOKE CLOSE,
CAMERON PARK N.S.W. 2285
P: 02 4903 4800
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electronics@ampcontrolgroup.com
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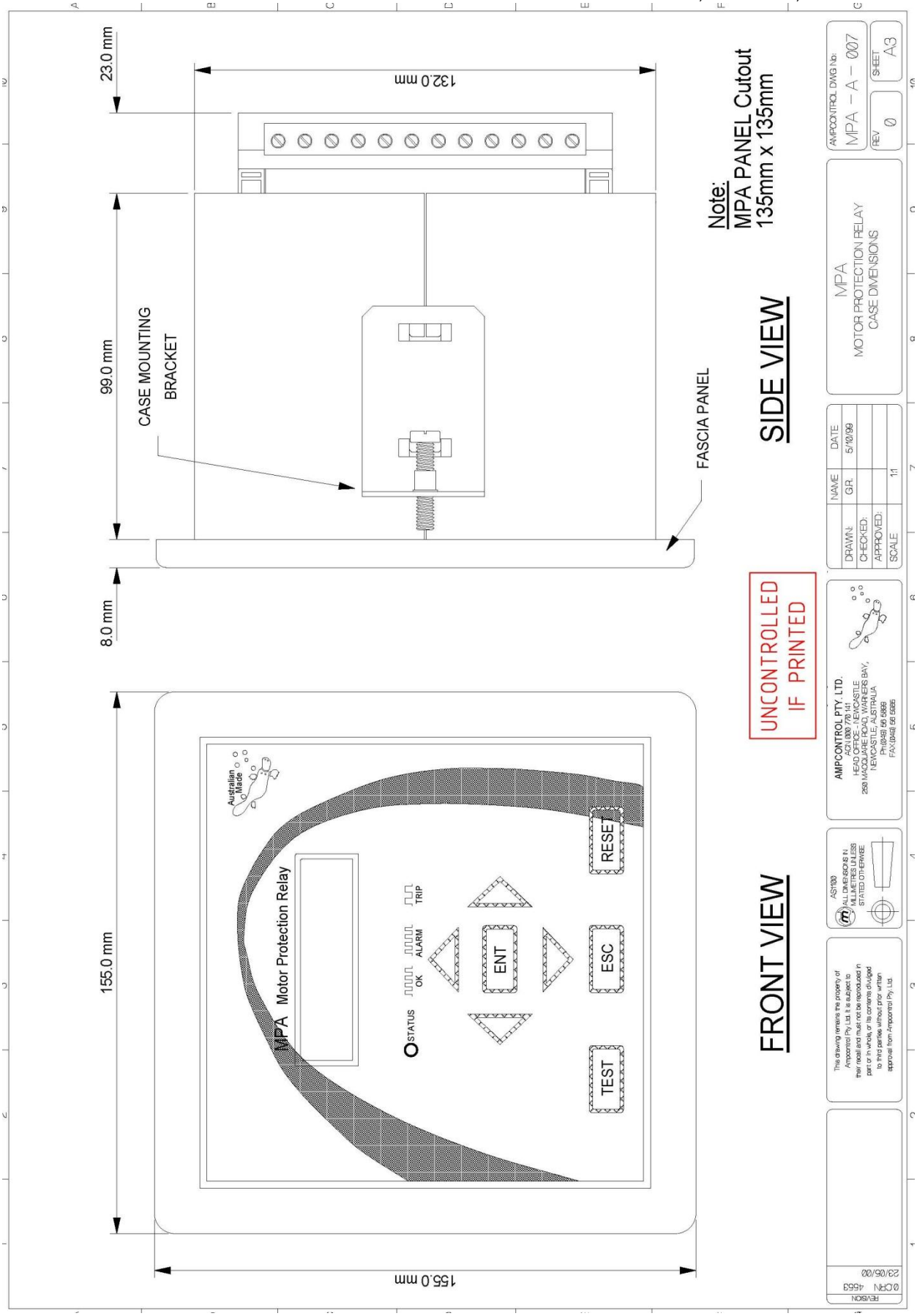
GENERAL LINEAR TOLERANCE = ± 0.2
GENERAL ANGULAR TOLERANCE = ± 1
DIMENSIONS IN mm DO NOT SCALE
AS 1100
REV. CRN NUMBER
2 8168
1 4838
0 4553


23.0 mm
132.0 mm
99.0 mm
CASE MOUNTING BRACKET
FASCIA PANEL
8.0 mm
155.0 mm
155.0 mm
Note:
MPA PANEL Cutout
135mm x 135mm
SIDE VIEW
FRONT VIEW
UNCONTROLLED IF PRINTED
MPA Motor Protection Relay
Australian Made
STATUS
OK
ALARM
TRIP
ENT
ESC
RESET
TEST
AMPCONTROL PTY. LTD.
MPA – A – 007
MPA
MOTOR PROTECTION RELAY
CASE DIMENSIONS
DRAWN: GR 5/10/99
CHECKED:
APPROVED:
SCALE 1:1
SHEET A3
REV 0
AS1100
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0 CRN 4663
23/05/00